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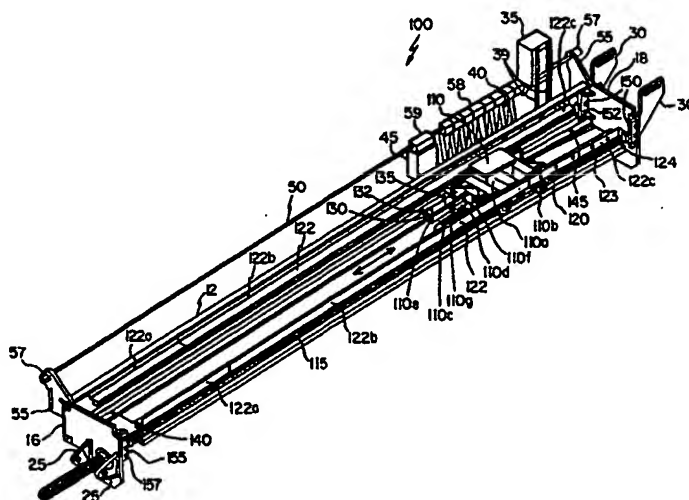
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(54) Title: SOOTBLOWER WITH TRAVELLING LIMIT SWITCH



(57) Abstract

A retractable sootblower (100), having a movable carriage and lance tube assembly (110, 115) for cleaning inside surfaces of a boiler, includes a stationary starter switch (37) for initiating operation of the sootblower (100) and a cable (40) disposed between the movable assembly (110, 115) and the starter switch (37) for transmitting electrical current from the starter switch (37) to the moveable assembly (110, 115). A limit switch (130) is mounted to and moveable with the moveable assembly (110, 115). A stationary switch control device (140) is disposed proximate the boiler and configured to cooperate with the limit switch (130) so as to reverse the direction of movement of the moveable assembly (110, 115) during sootblower (100) operation by reversing the direction of the current to the moveable assembly (110, 115).

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SOOTBLOWER WITH TRAVELLING LIMIT SWITCHTechnical Field

5 The present invention relates to sootblowers for cleaning inside surfaces of a boiler and more particularly to a retractable sootblower with a travelling limit switch.

10 Background Art

 In the combustion of fuels used to power industrial, utility and other types of boilers, by-products such as soot, ash and slag often accumulate on the interior surfaces of the boiler. The accumulation of these by-products decreases the efficiency of the heat transfer. Accordingly, to clean such by-products from the heat exchanging surfaces of the boiler, sootblowers are conventionally utilized.

 Typically, sootblowers include a tubular lance which extends through a port in the boiler wall. A cleaning medium such as steam is then introduced via the lance to wash the inner surfaces of the boiler to remove the combustion by-products. In large boilers, retractable sootblowers are commonly utilized. The lance of the retractable sootblower is mounted to a carriage which is supported by parallel tracks mounted inside the sootblower frame or housing. When the sootblower is operated, the carriage is driven by an internal motor along the tracks to insert or inject the lance tube into the boiler during sootblower operation to discharge the cleaning medium against the heat exchanging surfaces of the boiler and thereby clean the combustion by-products from the boiler's interior. After the lance has been fully extended into the boiler, the travel direction of

the carriage is reversed to withdraw the lance from the boiler. Retractable sootblower carriages could be adapted to insert and withdraw the lance tube multiple times during each operational period. However, sootblowers are most typically designed such that the lance tube is inserted once and withdrawn during each operational period. When the retractable sootblower is not in operation, the carriage remains in its parked position at the back end of the sootblower housing.

10 The reversal of the travel direction of the carriage requires that a limit switch be provided to limit the carriage movement. Conventionally, limit switches are mounted at each end of the sootblower frame and connected to the carriage motor by electrical cable. As the carriage moves from a parked position at the rear of the sootblower frame towards the boiler, it makes contact with the front limit switch which reverses the direction of current being supplied to the carriage motor thereby reversing the direction of movement of the carriage. The carriage then moves towards the rear of the sootblower frame until making contact with the rear limit switch which opens the circuit between the power source and the carriage motor thereby stopping the motor's operation and the further movement of the carriage. Of course, if it is desired that the sootblower cycle multiple times during each operational period, a more robust rear limit switch will be required.

30 The interior temperatures of boilers in which retractable sootblowers are used is typically extremely high. Furthermore, the gases which form part of the combustion by-products are highly corrosive. These extremely hot and corrosive gases can escape from the boiler interior through the lance tube insertion port. To reduce the transfer of heat and corrosive gas to the sootblower, a wall box may be installed on the boiler wall to cover the lance tube injection port. However, in

practice, although this may reduce the heat and gas transferred to the sootblower housing, even using a wall box, the hot gases escaping into the sootblower housing will result in an extremely harsh environment in the area closest to the boiler which is particularly damaging to electrical and mechanical components. Hence, in conventional sootblowers, the front limit switch is subjected to extreme heat and corrosion. Therefore, this limit switch is typically a high maintenance item which must be frequently serviced and replaced.

Conventional sootblower housings are sometimes referred to as closed frame or open frame housings or beams. Closed frame housings may, for example, be made of one or more metal plates formed into an elongated inverted U-shaped member which houses and supports the sootblower carriage and lance tube, the limit switches and other sootblower components. Metal plates are typically welded on both ends of the elongated inverted U-shaped member to form a substantially rectangular box housing for the sootblower components. The front end of the housing is supported from the boiler wall or a wall box attached thereto. The rear or back end of the housing is most often supported from the surrounding structural steel framing. This configuration provides protection for the sootblower components from above and allows substantially unobstructed access to the sootblower components from below. Although the upper portion of the inverted U-shaped housing protects the sootblower components from above, it also obstructs access to these components from above and traps the hot corrosive gases which escape from the boiler interior within the housing.

Conventional open sootblower frames have been utilized to provide substantially unobstructed access to the sootblower carriage, lance tube and other components from above. Such frames also provide improved

dissipation of hot gas emissions from the boiler. Even in open frame systems, installation and removal of sootblower components from above is often obstructed to some extent by removable stiffening members installed between the upper side walls of such sootblower frames for lateral stability, and by the tracks or rails which guide the carriage movement. While open frame systems improve the venting of hot corrosive gases escaping through the lance tube injection port and improve access to the sootblower components from above, these benefits come at the cost of having the sootblower components unprotected from above. Further, even if the sootblower components are accessible from above and below, the location of structural support steel, boiler piping and other boiler related components in the vicinity of the sootblower may make it difficult to access, install or remove sootblower components on-site.

Frequently, the lance tube is designed to be positioned off center. This is typically characterized as handedness. A sootblower is characterized as having lefthandedness or righthandedness depending on the side of the frame on which the lance tube valve operating mechanism is located from the perspective of an observer looking from the back end of the sootblower frame towards the boiler. Due to, for example, field modifications to the boiler system or the structural steel support framing, it is sometimes necessary to change the handedness of the sootblower. However, such a change is often difficult, if not impossible to accommodate with conventional sootblower frames.

Objectives of the Invention

Accordingly it is an objective of the present invention to provide a sootblower with reduced maintenance requirements.

It is a further objective of the present invention to provide a sootblower with a longer life limit switch.

It is yet another objective of the present invention to provide a sootblower particularly suitable for use in
5 paper and pulp mill and other implementations having boilers which burn fuels producing highly corrosive high temperature gasses.

Additional objects, advantages, novel features of the present invention will become apparent to those
10 skilled in the art from this disclosure, including the following detailed description, as well as by practice of the invention. While the invention is described below with reference to a preferred embodiment(s), it should be understood that the invention is not limited thereto.
15 Those of ordinary skill in the art having access to the teachings herein will recognize additional implementations, modifications, and embodiments, as well as other fields of use, which are within the scope of the invention as disclosed and claimed herein and with
20 respect to which the invention could be of significant utility.

Summary Disclosure of the Invention

In accordance with the present invention, a
25 retractable sootblower, having a movable carriage and lance tube assembly for cleaning inside surfaces of a boiler, includes a stationary starter switch for initiating operation of the sootblower and a power cable, e.g. an electrical cable, disposed between the movable
30 assembly and the starter switch for transmitting electrical current from the starter switch to the moveable assembly. A limit switch, for reversing the electrical current to the movable assembly, is moveable with the moveable assembly and may be advantageously
35 mounted thereto. A stationary switch control device, such as a pin, is disposed proximate the boiler and

configured to cooperate with the limit switch so as to reverse the electrical current to and thereby reverse the direction of movement of the moveable assembly during sootblower operations.

5 More particularly, the limit switch and the stationary switch control device cooperate to limit the travel of the moveable carriage from a parked position distal to the boiler to a position proximate the boiler and in which the lance tube is fully extended, i.e.
10 inserted, into the boiler during sootblower operation. The limit switch may include a flexible member configured to operate the limit switch when the flex member contacts the stationary switch control device to reverse the direction of movement of the moveable assembly.
15 Beneficially, the stationary switch control device is mountable at different locations to change the location at which the direction of movement of the moveable assembly is reversed.

Typically, a second limit switch is also provided so
20 as to be moveable with the moveable assembly and is advantageously mounted thereto. A second stationary switch control device is located distal the boiler and is configured to cooperate with the second limit switch so as to cut off power to the moveable assembly by
25 deenergizing the carriage motor once an operational cycle has been completed. In this regard, it will be understood that the first limit switch cooperates with the first stationary switch control device to limit movement of the moveable carriage towards the boiler and
30 the second limit switch cooperates with the second stationary switch control device to park the moveable carriage away from the boiler when operation of the sootblower has been completed.

Typically, the retractable sootblower will include
35 a frame for housing the moveable assembly and limit switch. The stationary starter switch is preferably

mounted proximate to the back or rear end of the frame, i.e. the end farthest from the boiler. One stationary switch control device is mounted proximate to the front end of the frame, i.e. the end closest to the boiler. The moveable carriage is disposed in a parked position proximate the rear end of the frame during periods when the sootblower is non-operational. Hence, both the carriage and limit switches are distanced from the boiler and located away from high temperature corrosive gasses generated by and escaping from the boiler when the sootblower is not in operation.

One end of the power cable will necessarily move with the carriage while the other end of the cable will typically be held stationary. According to one aspect of the invention, a cable support assembly is provided to support the cable during sootblower operations, when the carriage moves between the parked and the extended lance tube positions, as well as during non-operational periods when the carriage is in the parked position. Preferably, the cable support assembly includes a bar, such as a stainless steel rod, mounted so as to be stationary with respect to the moving carriage. The use of a stainless steel rod is particularly beneficial in high corrosive environments such as those which exist in pulp and paper operations. One or more festoon members, such as nylon blocks, are movably, e.g. slideably, mounted to the bar. The cable is attached to festoon members which move along the bar to support the cable during the movement of the carriage.

In accordance with other aspects of the invention, the cable support assembly includes first and second support brackets attached to an outer surface of the sootblower frame. One of the support brackets is located near the rear end of the frame and the other is located near the front end of the frame. Each of the support brackets has an aperture. The bar is located between the

support brackets, with respective end portions of the bar extending through the aperture in each of the support brackets. One or more connectors are provided for tensioning the bar between the first and second support
5 brackets to thereby substantially eliminate sag or droop in the bar. For example, one or both end portions of the bar may be threaded and nuts may be used as the connectors to tension the bar. Eliminating sag in the bar prevents binding of the festoon members as they slide
10 or otherwise travel along the bar while supporting the cable during movement of the carriage.

A junction box is advantageously provided between the starter switch and the moveable carriage. One end of the cable is connected to the junction box. The junction
15 box is preferably attached to and moveable with the carriage, and supported by at least one of the festoon members.

Brief Description of Drawings

20 Figure 1 is a perspective view of a retractable sootblower in accordance with the present invention.

Figure 2 is a perspective view of the Figure 1 sootblower with the top panels and one side wall removed.

25 Figure 3 is an enlargement of the back-end of the sootblower as shown in Figure 2.

Figure 4 is an enlargement of the back-end of the sootblower as shown in Figure 1 with the top panels and one side wall removed.

30 Figure 5A is a top view of the top panels depicted in Figure 1.

Figure 5B is an elevation view of the top panels depicted in Figure 5A.

Figure 6A is an elevation view of the hinge member shown in Figures 5A and 5B.

35 Figures 6B is a side view of the hinge member shown in Figure 6A.

Figure 7A details the hinge pin and restraining washers shown in Figures 5A and 5B.

Figure 7B provides further details regarding the restraining washer depicted in Figure 7A.

5

Best Mode for Carrying out the Invention

Figure 1 depicts a perspective view of a sootblower 100 in accordance with the present invention. The sootblower includes a frame 10 formed of opposed side walls 12 and 14 which in the embodiment shown are C15 x 3 3/8 channel members flanged inwardly. The frame also includes a front wall 16 and rear wall 18. As will be described further below the front and rear walls are removably connected to the opposed side walls to form a generally rectangular shaped box for housing sootblower components. The frame also includes grated panels 20 which are connected to one of the side walls by hinge assemblies 22 at opposed corners of each panel 20.

The panels 20 are rotatable between closed and opened positions. When the panels 20 are in the closed position, they extend across the side walls hence closing the frame 10 and providing protection from above to the sootblower components housed within the frame 10, including lance tube 115. Because grated panels are used, hot corrosive gases escaping from the boiler through the lance tube port are not trapped within the frame 10 but will be quickly and continuously dispersed. When access to the sootblower components from above is required for maintenance, installation or removal, the panels can be opened as shown by alternate panels 20 in Figure 1. The top panels 20 are opened by simply rotating each panel about its connecting hinge assemblies 22. The front wall 16 has support brackets 25 attached thereto for connecting that end of the sootblower frame to a boiler wall box to support that end of the sootblower. The rear wall has support brackets 30

attached thereto for connection to, for example, structure steel framing which is in the vicinity of the back end of the sootblower to thereby provide two end support for the sootblower.

5 A starter cabinet 35 having a starter switch 37 is mounted to the side wall 12. An electrical power cable 40 extends between the starter box 35 and a junction box 45 which is in turn connected physically to the sootblower carriage by support structure 47 and member
10 49, as will be described further below. The cable 40 is festooned between the starter cabinet 35 and the junction box 45. Power, i.e., electrical current, is transmitted from the junction box 45 to the carriage motor via the limit switches. The cable 40 and junction box 45 are
15 supported by a stainless steel bar 50 which extends between support brackets 55 attached to side wall 12 of the frame 10. Each of the support brackets 55 has an aperture through which the bar 50 extends. The ends of the bar 50 are threaded so that the bar 50 is locked in
20 place by threaded nuts 57 which are tightened to tension the bar 50 between the support brackets 55 to remove, to the extent practicable, any sag in the support bar 50.

Eight festoon blocks 58, which are formed of nylon, connect the cable 40 to the bar 50 between the starter
25 cabinet 35 and junction box 45. The number of festoon blocks 58 can be increased or decreased as desired for the particular implementation. A somewhat larger festoon block 59, which is also formed of nylon, connects the junction box 45 to the support bar 50. The nylon festoon
30 blocks slide along the support bar 50 as the sootblower carriage moves between a parked position towards the rear of the frame and a position at which the sootblower lance tube 115 is fully inserted into the boiler interior.

It will be understood by those skilled in the art,
35 that the top grated panels 20 could, if desired, be replaced by other panel designs. For example, perforated

steel plates could be utilized in lieu of the grated panels. However, this could substantially increase the weight of the panels and hence make it more difficult to open the panels to gain access to sootblower components housed within the frame 10. It will also be recognized that other assemblies could be used to support the cable, so long as the assembly utilized provides support to the cable as the distance between the starter cabinet 35 and junction box 45 increases and decreases during operation of the sootblower.

Turning now also to Figure 2, a cutaway view of the sootblower 100 is depicted with one of the side walls and the top grated panels removed. As shown, the sootblower components housed within the frame include a carriage assembly 110 having a housing 110a to which a lance tube 115 is mounted. The carriage assembly 110 rides on wheels 110b along conventional lower guide tracks or rails 120 mounted to each of the side walls 12 which is shown and 14 which is not shown in Figure 2. A multi-section upper guide track or rail 122 is formed of multiple sections of steel angle 122a 122b and 122c. Sections 122a and 122b are welded and hence permanently mounted to the side walls 12 and 14. Sections 122c are removably mounted with threaded connectors through the holes 123 formed in the vertical leg of each of the angles 122c. By opening the necessary grated panels 20, and unbolting track sections 122c, the carriage 110 can be easily removed from or installed in the sootblower frame 10.

As shown, the carriage assembly 110 includes an electrical motor 110c which is mounted to the carriage housing 110a. A bracket 110d is attached to the motor 110c housing and supports tubular members 110e and 110f. Mounted to tubular member 110e is a front limit switch 130. A rear limit switch 135 is mounted to the tubular member 110f. A pin 140, removably mounted to side wall

12

12, cooperates with the limit switch 130 to reverse the direction of the carriage 110 by reversing the current to the electrical motor 122 when the flexible whip member 132 of front limit switch 130 makes contact with the pin 140. The pin 140 is inserted through an aperture (not shown) in the side wall 12. By forming multiple apertures in the side wall 12, the pin 140 can be relocated as desired to increase or reduce the total travel distance of the carriage 110 between its parked disposition near the rear end of the frame 10 and the front of the frame 10.

Although not shown, a similar flexible whip member is also provided on the rear limit switch 135 which cooperates with a second pin 145 located towards the rear of the sootblower frame 10 to open the electrical circuit and thereby cut-off power to the carriage motor 110c when the carriage returns to the desired parked position. The de-energizing of the carriage motor ends operation of the sootblower. If each period of operation of the sootblower will require multiple cycling of the lance tube in and out of the boiler interior, a more robust rear limit switch will be required, as will be well understood by the artisan. However, customarily, the sootblower will run through a single cycle during each operation and a limit switch of the type shown will be sufficient. As with pin 140, pin 145 is removable and can be inserted in any of multiple apertures (not shown) formed in the side wall 12 towards the back end of the frame 10 to modify the location where the carriage will be parked during non-operation of the sootblower. Alternatively, if it is desired that the carriage always be parked in the same position, the pin 145 can be permanently mounted to the side wall 12.

Although the limit switches 130 and 135, and the corresponding pins 140 and 145, are shown to be in particular locations and supported in a particular

manner, various alternatives exist for mounting the limit switches 130 and 135 and the pins 140 and 145. What is of primary importance is that the limit switches 130 and 135 are mounted to travel with the carriage 110. This ensures that the limit switches 130 and 135 are only subjected to the hot corrosive gases escaping from the boiler and into the front end of the frame 10 through the lance tube port during each operational period when the carriage moves to a position close to the front end of the frame 10. During all other periods, the carriage 110 and hence, the limit switches 130 and 135, will be parked proximate to the back end of the frame 10 and away from the escaping gas. Therefore, the limit switches will experience an extremely hot and corrosive environment during a substantially reduced period of time as compared with limit switches used in conventional retractable sootblowers. This in turn will reduce the amount of maintenance required on the limit switches 130 and 135 and will increase their operational life.

Brackets 155 are attached to the interior surface of both sides of the front wall 16 to provide for removable mounting of front wall 16 to the side walls 12 and 14 using threaded connectors 157. The mounting of front wall 16 in this manner allows the wall 16 to be removed and replaced by a mirror image wall to change the handedness of the sootblower from the righthanded disposition shown to a lefthanded disposition. This is particularly advantageous in situations where, for example, the handedness of the sootblower must be modified in the field. In changing the handedness of the sootblower 100, the pins 140 and 145 are moved to the other side wall 14 which will beneficially also include pre-drilled apertures to accept the pins.

Rear wall 18 has brackets 150 attached thereto which are connected by bolts 152 to the side walls 12 and 14 (not shown in Figure 2) to mount the rear wall. Rear

wall 18 has the steam inlet pipe passing therethrough in alignment with lance tube 115. To change the handedness of the sootblower 100, the rear wall 18 must also be removed and replaced by a mirror image wall. Removable
5 mounting of the rear wall also allows rear wall 18 to be easily unbolted and removed to provide rear access for installation and removal of the carriage 110 and lance tube 115 from behind the sootblower.

Figure 3 depicts an enlarged view of the rear end of
10 the sootblower 100 with the top panels and one of the side walls removed. The view is identical that depicted in Figure 2 but enlarged for the convenience of the reader. Hence, only selected components of the sootblower 100 will be further discussed with reference
15 to Figure 3 to avoid unnecessary duplication.

As shown, the limit switches 130 and 135 are supported by the tubular members 110e and 110f which are connected to the housing of the electrical motor 100c by the bracket 110g. Limit switch 130 includes a flexible
20 whip member 132 which mechanically operates the switch to change its circuitry and thereby reverse the current to the electrical motor 110c when the flexible member 132 physically contacts the pin 140 as the carriage 110 moves towards the boiler. The flex member 132, which could
25 take the form of a spiral wound spring, bends as it contacts pin 140 to trip the limit switch 130 circuitry into a reversed current mode, as will be well understood by the skilled artisan.

A substantially identical flex member (not shown) is
30 also included as part of limit switch 135 for contact with pin 145 to open the circuitry of limit switch 135 when the parked position is reached by the carriage 110. Since sootblower 100 is a single cycle sootblower, the lance tube moves through a single cycle during each
35 operational period initiated by switch 37 on the starter cabinet 35. Accordingly, when the flexible member on the

limit switch 135 contacts the pin 145, limit switch 135 is mechanically operated to shut off power to and hence de-energize the motor 110c.

As discussed above, one or both of the pins 140 and 145 are movable along the length of the sootblower frame 10 so that the travel distance and/or location of the carriage 110 in its parked disposition can be modified as desired. The travelling limit switches arranged as described herein can be advantageously utilized with any carriage and lance tube design.

As shown in Figure 3, the starter cabinet 35 is supported from angular members 39 which are attached to the side wall 12 by the bolted connectors 124 which extend through holes 123 to also attach the removable sections 122c of the guide rails 122 to the side wall. This allows the starter cabinet 35 and supporting members 39 to be easily moved to the other wall 14 of the frame 10 if the sootblower handedness is changed.

Figure 4 is an enlarged view of the back or rear end of the sootblower 100 with the panels 20 and the far side wall 14 removed. Figure 4 will be particularly helpful in understanding the operation of the festoon system supporting the power cable 40 and junction box 45. As shown, the carriage assembly 110 includes a support member 49 attached thereto and moveable therewith for driving the movement of the junction box 45 with the carriage 110. More particularly, the junction box is attached to support structure 47 which is formed of structural angles 47a connected to a tubular member 47b which is in turn mounted to the support member 49. Support member 49 may be a tubular member with outer dimensions slightly smaller than the inner dimensions of the tubular member 47b such that member 49 can be inserted into member 47b and locked in place with, for example, a bolt or cotter pin (not shown) or by welding performed on site.

As the carriage 110 is driven by its motor 110c either towards or away from the boiler, the support member 49 moves therewith, thereby moving structure 47 and the junction box 45. The junction box 45 is, as previously described, also attached to a festoon block 59 which slides along the rod 50. As the junction box 45 is driven towards the boiler by the carriage 110, the cable 40 is pulled by the junction box 45, while remaining supported by the sliding festoon blocks 58 from the rod 50. The festoon system allows the length of the power cable 40 to be extended without interfering with the movement of the carriage 110 or junction box 45 until the travel direction is reversed by limit switch 130. As the carriage then moves away from the boiler, festoon block 59 pushes against festoon blocks 58 to fold cable 40 and thereby decrease the length of the cable 40 as the carriage 110 moves back to its parked position.

Figure 5A depicts a somewhat enlarged top or plan view and Figure 5B depicts an elevation view of grated panels 20 and hinge assemblies 22. The panels 20 include side members 20a which are preferably in the form of structural steel angle members. An aperture is formed in one flange of each of the side members 20a to accept a pin 22b. Each hinge assembly 22 also includes a steel hinge plate 22a which is preferably welded to the exterior side of the side member 14. The pin 22b is inserted through the apertures in the adjacent side members 20a and the hinge plate 22a to rotatably connect the grated panels 20 to the frame 10. The pins 22b are permanently restrained by washers 22c which are welded to each end of the pins 22b and which may also be welded to the side members 20a. It will be understood that at each end of the frame 10, the hinge pin will connect only a single panel 20 to the hinge plate 22a. Accordingly, pins somewhat shorter than pins 22b can, if desired, be utilized at the ends of the sootblower frame 10.

As shown in Figures 5A and 5B, the grated panels 20 are formed of barstock having a height of one inch. The side members 20a have one inch flanges. Each panel's overall dimensions are approximately two by four feet, the two foot dimension corresponding to the separation between the vertical webs of the side walls 12 and 14. Larger or smaller panels could of course be used, the panel dimensions being dictated by the dimensions of the frame. For example, the dimension between the side walls will typically vary depending upon the carriage gear box size.

The non-hinged end of each grated panel 20 will beneficially be forced into contact with side wall member 12 by tension latch and keeper assembly 23 which, for example, may be of the type commercially manufactured by SOUTHCO, Incorporated under part numbers V2-0025-52 and V2-0018-52 or an equivalent thereto. The latch and keeper assembly 23 will, among other things, prevent vibration of the grated panels 20 against the side wall 12. The latched panels 20 may also provide some lateral support to the side walls 12 and 14, although this is unnecessary in the preferred embodiment which utilizes side walls in the form of channel members. The flanges of the channel members independently provide sufficient lateral stiffening.

Figures 6A and 6B depict a hinge plate 22a suitable for use in the embodiment of the sootblower 100 described above. Figures 7A and 7B depict a pin 22b formed of tubular steel and washers 22c which are preferably welded to the pin 22b as discussed above. As indicated, the restraining washers 22c have an aperture only slightly larger than the outer diameter of the pin 22b.

As described above, a closed frame sootblower is provided which beneficially includes grated top panels which can be moved to provide substantially unrestricted access to the sootblower components from above.

Removable front and rear walls facilitate easy modification of the handedness of the sootblower. The removable rear wall also allows access to the carriage and tube from behind. Further, by utilizing upper carriage guides or rails which include a removable section, the removal and installation of the carriage from above is further facilitated.

To reduce the sootblower maintenance requirements, the carriage limit switches are designed to travel with the carriage and accordingly are kept away from boiler heat and escaping corrosive gases when the sootblower is not in operation, i.e. when the sootblower is in a parked disposition. By utilizing adjustable pins which cooperate with the moving limit switches, the travel distance of the carriage can be easily adjusted as may be desired. A festoon system facilitates the extension and retraction of the carriage power cable as the carriage moves towards and away from the boiler.

It will also be recognized by those skilled in the art that, while the invention has been described above in terms of one or more preferred embodiments, it is not limited thereto. Various features and aspects of the above described invention may be used individually or jointly. Further, although the invention has been described in the context of its implementation in a particular environment and for particular purposes, those skilled in the art will recognize that its usefulness is not limited thereto and that the present invention can be beneficially utilized in any number of environments and implementations. Accordingly, the claims set forth below should be construed in view of the full breath and spirit of the invention as disclosed herein.

As described in detail above, the present invention provides a reduced maintenance sootblower with a long life limit switch. The inventive sootblower is particularly suitable for use in paper and pulp mill and

other implementations in which boilers produce highly corrosive high temperature gasses.

It will also be recognized by those skilled in the art that, while the invention has been described above in terms of one or more preferred embodiments, it is not limited thereto. Various features and aspects of the above described invention may be used individually or jointly. Further, although the invention has been described in the context of its implementation in a particular environment and for particular purposes, those skilled in the art will recognize that its usefulness is not limited thereto and that the present invention can be beneficially utilized in any number of environments and implementations. Accordingly, the claims set forth below should be construed in view of the full breath and spirit of the invention as disclosed herein.

CLAIMS

1. A retractable sootblower, having a movable
5 carriage and lance tube assembly for cleaning inside
surfaces of a boiler, comprising:

a stationary starter switch for initiating operation
of the sootblower;

a power cable disposed between the movable assembly
10 and the starter switch and configured to transmit
electrical current from the starter switch to the
moveable assembly;

a limit switch mounted to and moveable with the
moveable assembly; and

15 a stationary switch control device disposed
proximate the boiler and configured to cooperate with
said limit switch so as to reverse a direction of
movement of the moveable assembly during sootblower
operation by reversing the direction of the current to
20 the movable assembly.

2. A retractable sootblower according to claim 1,
further comprising:

a frame configured to house the moveable assembly
25 and having a front end disposed proximate and a rear end
disposed distal to the boiler;

wherein the stationary starter switch is mounted
proximate to the rear end of the frame, and the
stationary switch control device is mounted proximate to
30 the front end of the frame.

3. A retractable sootblower according to claim 1,
wherein:

the carriage is disposed in a parked position
35 proximate to the rear end of the frame during non-
operation of the sootblower; and

the limit switch and the stationary switch control device cooperate to limit travel of the carriage from the parked position to an extended lance tube position proximate to the front end of the frame during sootblower
5 operation.

4. A retractable sootblower according to claim 1, further comprising a frame configured to house the moveable assembly, and wherein:

10 the stationary starter switch is mounted to the frame distal to the boiler;

the stationary switch control device is mounted to the frame proximate to the boiler; and

15 the limit switch cooperates with the stationary switch control device to limit movement of the moveable carriage from a parked position distal to the boiler to an extended lance position proximate to the boiler during sootblower operation.

20 5. A retractable sootblower according to claim 1, wherein:

the limit switch cooperates with the stationary switch control device to limit movement of the moveable assembly such that the carriage moves between a parked
25 position distal to the boiler and an extended lance position proximate to the boiler during sootblower operation.

6. A retractable sootblower according to claim 1,
30 wherein the stationary switch control device is a pin and the limit switch includes a member configured to contact the pin to reverse the direction of the electrical current to the moveable assembly.

35 7. A retractable sootblower according to claim 6, wherein the pin is mountable at different locations to

change a location at which the direction of movement of the carriage is reversed.

8. A retractable sootblower according to claim 1,
5 further comprising:

a second limit switch mounted to and moveable with the moveable assembly; and

a second stationary switch control device disposed distal the boiler and configured to cooperate with said
10 limit switch so as to cut off electrical current to the moveable assembly to end sootblower operation;

wherein the limit switch cooperates with the stationary switch control device to limit movement of the moveable assembly towards the boiler and the second limit
15 switch cooperates with the second stationary switch control device to limit movement of the moveable assembly away from the boiler.

9. A retractable sootblower for cleaning inside
20 surfaces of a boiler, comprising:

a movable carriage;

a lance tube moveable with the carriage so as to be inserted into and withdrawn from the boiler; and

a limit switch moveable with the carriage and
25 configured to limit movement of the carriage during operation of the sootblower;

wherein, with the sootblower in a non-operational state, the carriage is positioned such that the limit switch is distal to said boiler.

30

10. A retractable sootblower according to claim 9, further comprising:

a stationary switch control device disposed proximate the boiler and configured to cooperate with
35 said limit switch so as to reverse a direction of movement of the carriage during sootblower operation.

11. A retractable sootblower according to claim 10, further comprising:

a frame configured to house the carriage and the lance tube, and having a front end disposed proximate and
5 a rear end disposed distal to the boiler;

a stationary starter switch mounted proximate to the rear end of the frame configured to initiate operation of the sootblower; and

a power cable extending between the carriage and the
10 starter switch and configured to transmit electrical current from the starter switch to the carriage;

wherein the stationary switch control device is mounted proximate to the front end of the frame and, with the sootblower in a non-operational state, the carriage
15 is positioned such that the limit switch is disposed proximate to the rear end of the frame.

12. A retractable sootblower according to claim 11, wherein the stationary switch control device is mountable
20 from the frame at different positions to change a location at which the direction of movement of the carriage is reversed.

13. A retractable sootblower according to claim 10, further comprising:
25

a second limit switch moveable with the carriage and configured to stop movement of the carriage to end operation of the sootblower;

a second stationary switch control device disposed
30 distal the boiler and configured to cooperate with said second limit switch so as to shut off electrical current to the carriage to end sootblower operation;

wherein the limit switch cooperates with the stationary switch control device to limit movement of the
35 carriage towards the boiler and the second limit switch cooperates with the second stationary switch control

device to limit movement of the carriage away from the boiler.

14. A retractable sootblower for cleaning inside
5 surfaces of a boiler, comprising:

a movable carriage;

a lance tube moveable with the carriage so as to be
inserted into and withdrawn from the boiler;

10 a limit switch moveable with the carriage and
configured to limit movement of the carriage between a
parked position distal to the boiler and a lance tube
inserted position proximate to the boiler during
operation of the sootblower;

15 a power cable configured to transmit electrical
current to the carriage and having one end moveable
therewith and another end stationary with respect
thereto; and

20 a cable support assembly configured to support said
cable during movement of the carriage between the parked
and the lance tube inserted positions.

15. A retractable sootblower according to claim 14,
wherein said cable support assembly includes:

25 a bar mounted so as to be stationary with respect to
said moveable carriage;

at least one festoon member movably mounted to said
bar and from which the cable is supported;

30 wherein, the at least one festoon member moves along
the bar to support said cable during the movement of the
carriage between the parked and the lance tube inserted
positions.

16. A retractable sootblower according to claim 15,
wherein the bar is formed of stainless steel.

17. A retractable sootblower according to claim 15, wherein the at least one festoon member is multiple festoon members each configured to slide along the bar, and further comprising:

5 a stationary starter switch to which the stationary end of the cable is connected, the stationary starter switch being mounted distal to the boiler and configured to initiate operation of the sootblower; and

10 a junction box to which the movable end of the cable is connected, the junction box being attached to one of said multiple festoon members and moveable with said carriage.

18. A retractable sootblower according to claim 14, further comprising:

15 a frame configured to house the carriage, the lance tube, and the limit switch, and having a front end disposed proximate and a rear end disposed distal to the boiler;

20 wherein the cable support assembly includes (i) a first support bracket attached to an outer surface of the frame proximate to the rear end thereof, and having a first aperture, (ii) a second support bracket attached to the outer surface of the frame proximate to the front end thereof, and having a second aperture, (iii) a bar disposed between the first support bracket and the second support bracket and having a first end portion extending through the first aperture and a second end portion extending through the second aperture, (iv) a connector attached to one of said first and said second end portions for tensioning said bar between the first and the second support members to thereby substantially eliminate sag in the bar, and (v) one or more festoon members movably mounted to the bar and configured to move along the bar to support the cable during the movement of the carriage between a parked position proximate to the

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rear end of the frame and a lance tube inserted position proximate to the front end of the frame.

19. A retractable sootblower according to claim 18,
5 further comprising:

a stationary starter switch to which the stationary end of the cable is connected, the stationary starter switch being mounted proximate to the rear end of the frame and configured to transmit electrical current to
10 the power cable; and

a junction box electrically interconnected to the limit switch and to which the movable end of the cable is connected, the junction box being attached to at least one of said festoon members and moveable with said
15 carriage.

20. A retractable sootblower according to claim 18, wherein said one or more festoon members are configured to be slidable along said bar.

20

21. A method of operating a retractable sootblower to clean inside surfaces of a boiler, the retractable sootblower having a carriage, a lance tube and a limit switch which limits the travel distance of the carriage,
25 comprising the steps of:

moving the carriage from a first position distal to the boiler to a second position proximate to the boiler, to thereby insert the lance tube into the boiler; and
moving the limit switch with the carriage.

30

22. A method of operating a retractable sootblower according to claim 21, further comprising the step of:

maintaining the carriage in the first position during non-operation of the sootblower;

35 wherein, with the carriage in the first position, the limit switch is disposed distal to the boiler.

23. A method of operating a retractable sootblower according to claim 21, wherein said sootblower further includes a cable configured to transmit electrical current to the carriage and having an end moveable with
5 the carriage, and a plurality of support members for supporting said cable along its length, and further comprising the step of:

moving said support members to support said cable during movement of the carriage between the first and the
10 second positions.

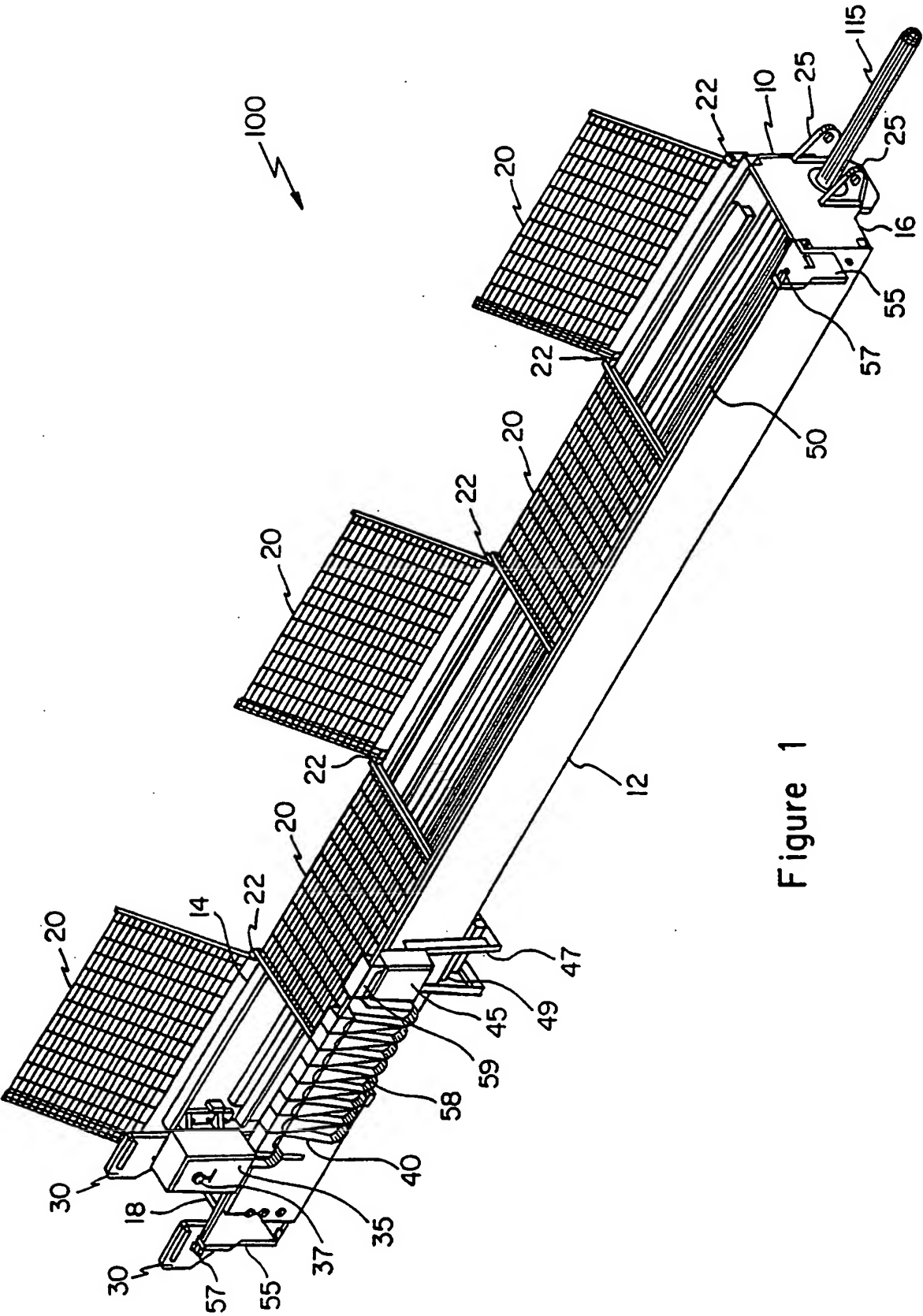


Figure 1

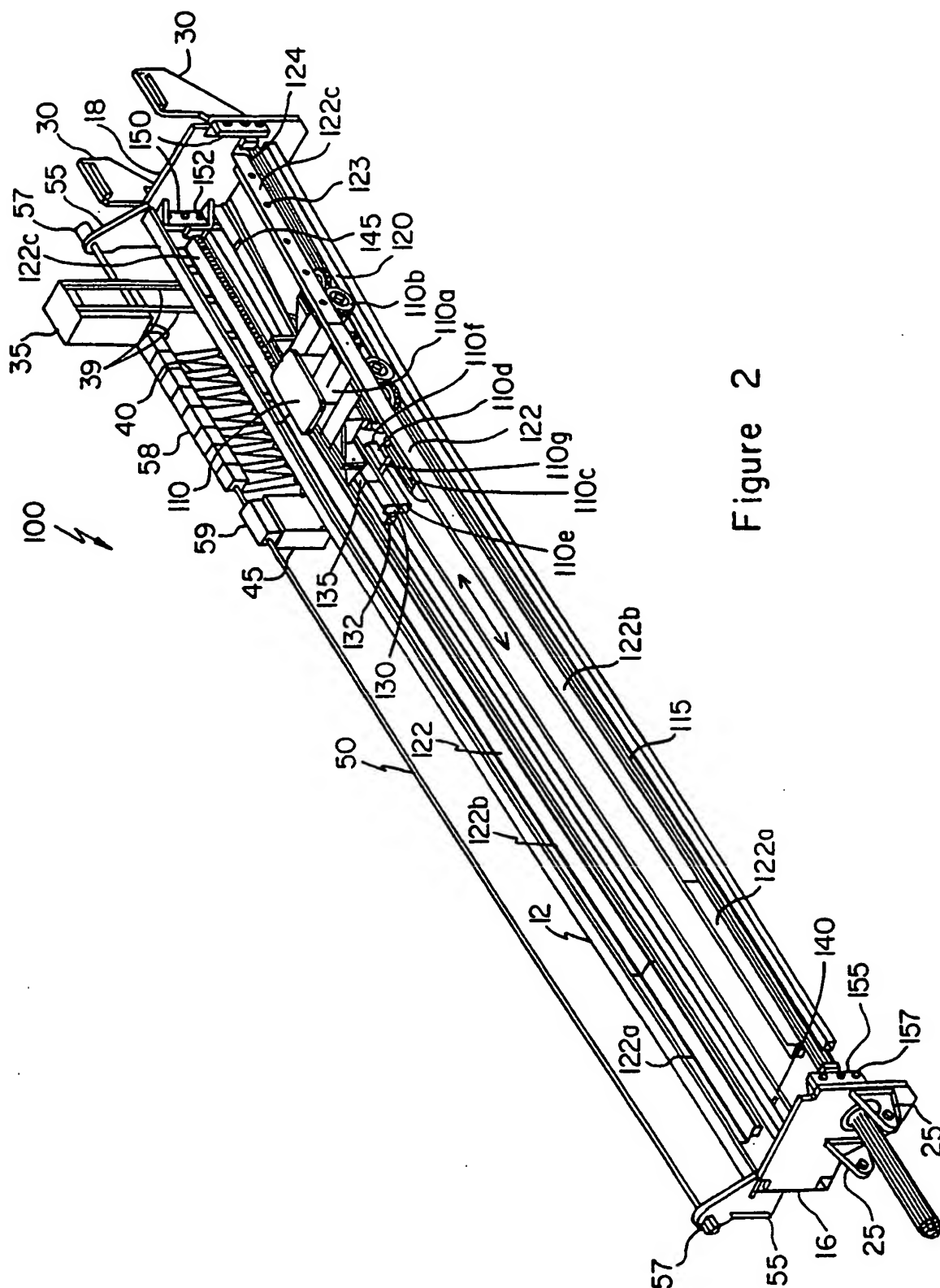


Figure 2

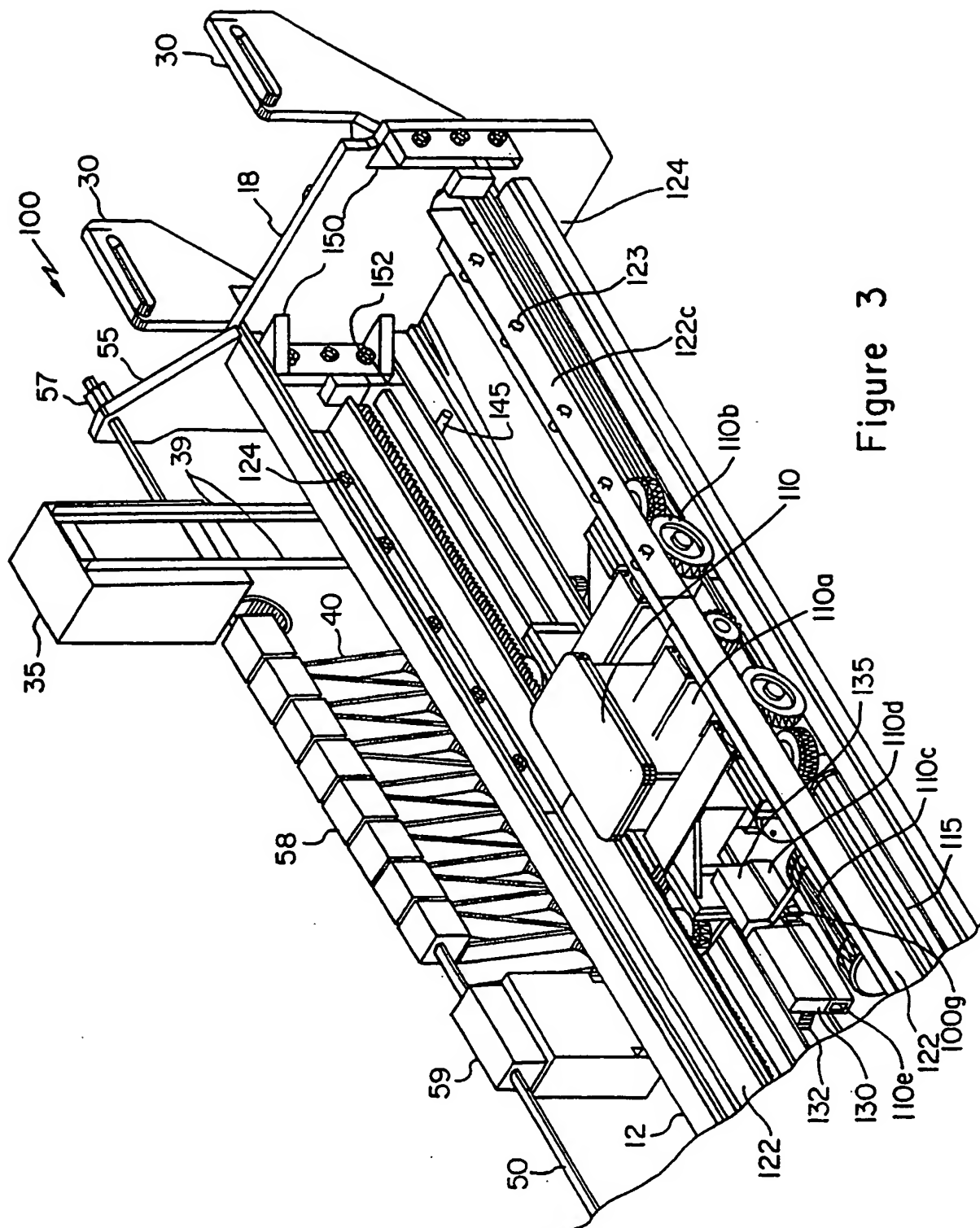


Figure 3

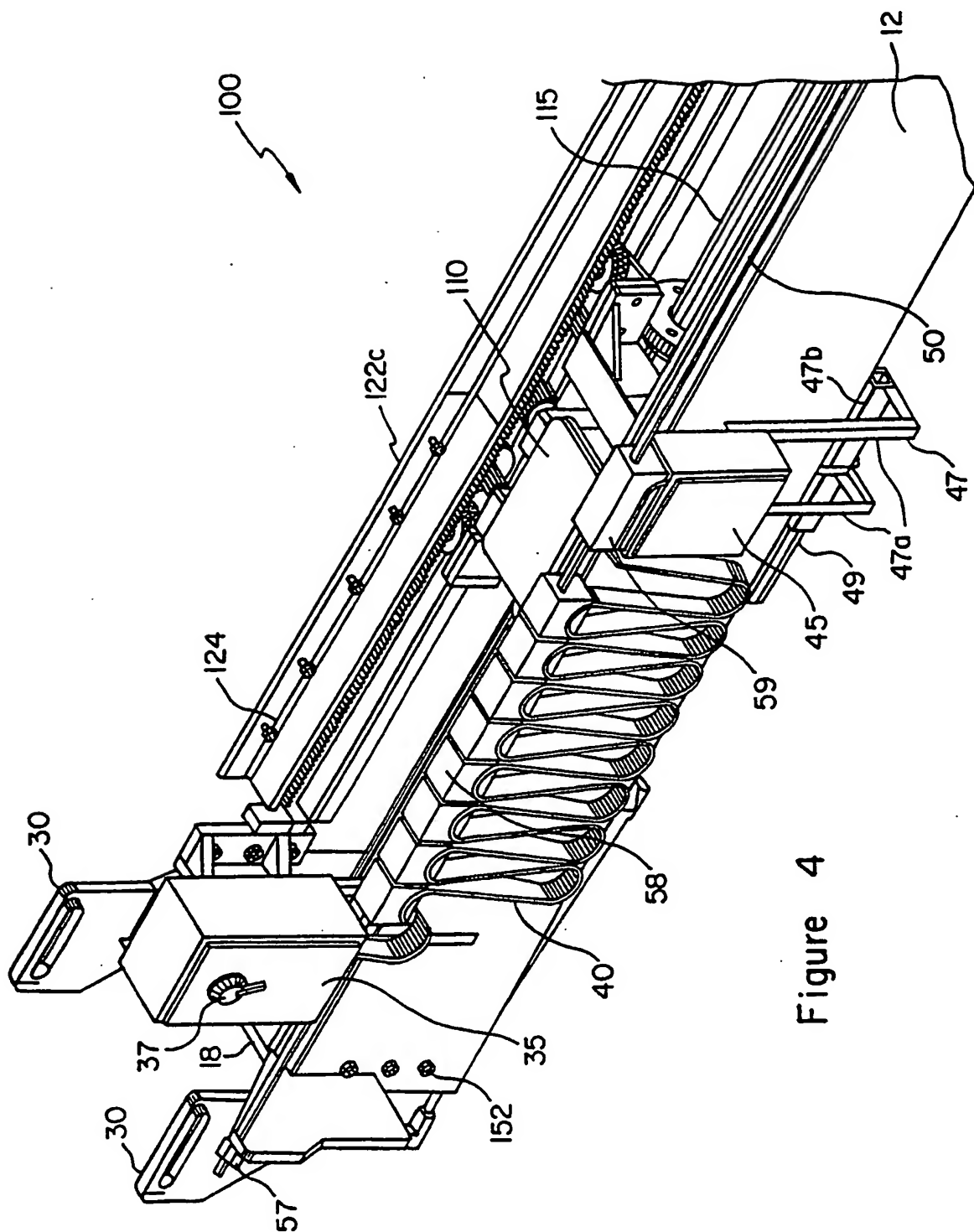


Figure 4

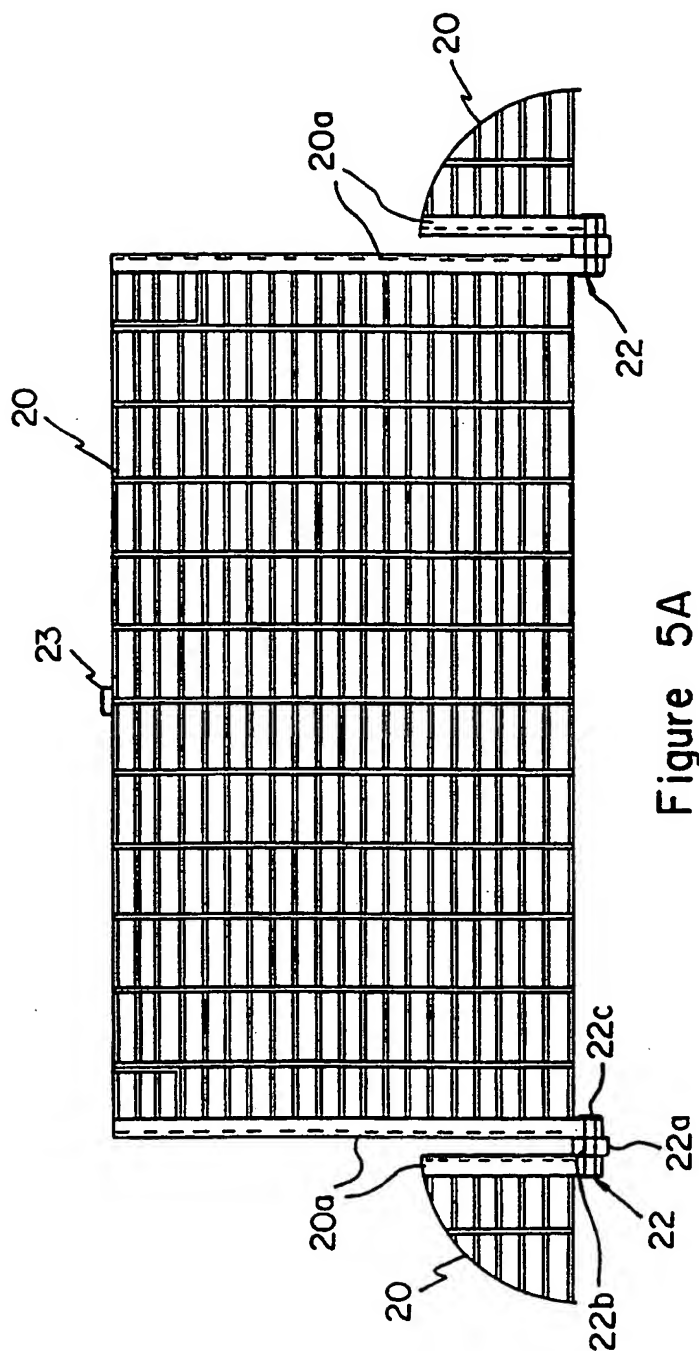


Figure 5A

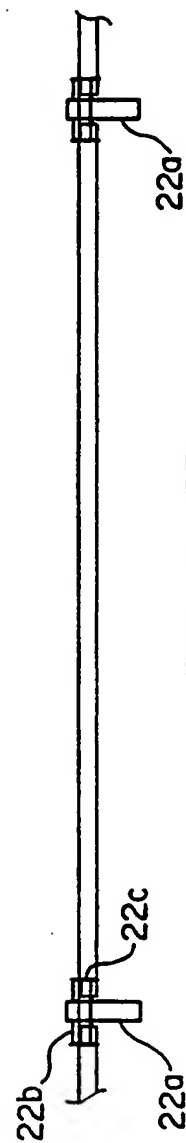


Figure 5B

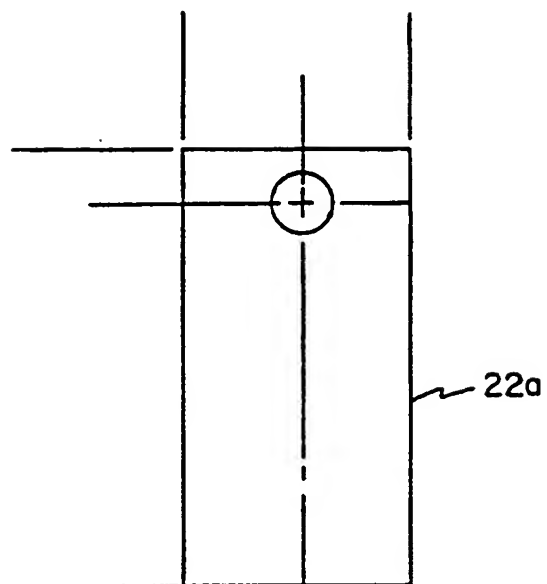


Figure 6A

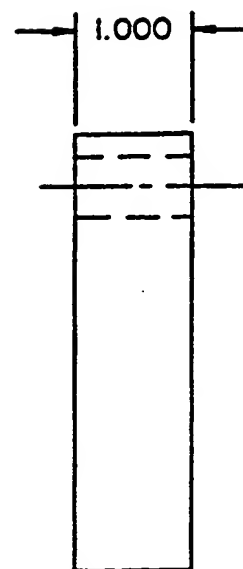


Figure 6B

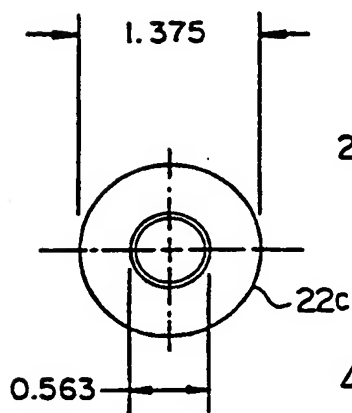


Figure 7B

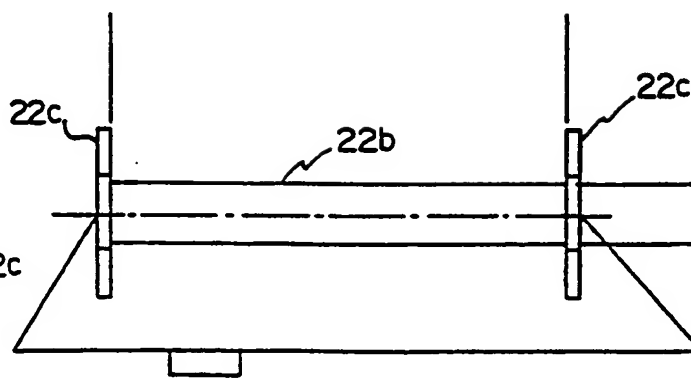


Figure 7A

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 98/00047

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F28G15/06 F28G15/04 F28G15/02

According to international Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 F28G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 061 515 A (BERGEMAN) 6 October 1982 see page 4, line 19 - line 30; figure 2 ---	1-14, 21, 22
A	GB 636 052 A (BABCOK & WILCOX) 19 April 1950 see page 5, line 104 - line 110; figure 1 see page 6, line 33 - line 40 ---	1-14, 21, 22
A	US 5 090 087 A (HIPPLE ET AL.) 25 February 1992 see column 4, line 13 - line 24; figure 1 ---	15-18, 23
A	GB 881 800 A (BRNENSKA ET AL.) 8 November 1961 see the whole document --- -/-	1, 9, 14, 21

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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- "A" document defining the general state of the art which is not considered to be of particular relevance
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- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

12 May 1998

Date of mailing of the international search report

20/05/1998

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 98/00047

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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